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A new genus and species of Collyriinae (Hymenoptera, Ichneumonidae)

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Abstract

An enigmatic taxon collected in China is described as *Bicurta sinica* **gen. n.**, **sp. n.** The unique specimen proved difficult to place to subfamily but has features in common with *Collyria*, until recently the sole valid genus of the small Palaearctic subfamily, Collyriinae. A morphological phylogenetic analysis of the pimpliformes group of subfamilies confirms the placement of this genus in the Collyriinae, which is here redefined.

Keywords

new genus, new species, taxonomy, China, Poemeniinae, pimpliformes

Introduction

The speciose family Ichneumonidae is currently divided into about 38 subfamilies (Quicke et al. 2009), although some groupings are treated differently by different authors (see, for example, the website of the American Entomological Institute: http://www.amentinst.org/). This large number of subfamilies has been divided into a num-

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ber of subfamily groupings, largely by the pioneering work of Wahl (1986, 1990, 1991) and Gauld (1985), with the details refined by Quicke et al. (2009). Although we are working towards a relatively stable higher classification of the Ichneumonidae, there are many areas of uncertainty, such as the classification of the various Ctenopelmatinae tribes in relation to several other subfamilies (Gauld and Wahl 2006; Quicke et al. 2009). Another area of difficulty is the pimpliformes group of subfamilies. Relationships within this clade (see Wahl 1986, 1990; Wahl and Gauld 1998; Quicke et al. 2009) have proved difficult to reconstruct, partly because of missing biological and larval information for some enigmatic taxa and partly because the 28S D2 ribosomal RNA data do not provide much support for subfamily or tribal relationships in this area. It can be inferred that the pimpliformes underwent a rapid radiation which has resulted in few discrete morphological apomorphies and the recognition of various very small groups of species as discrete subfamilies. One such subfamily is Collyriinae, comprising only one genus, *Collyria* Schiødte, until recently. After this paper was accepted for publication, Kuslitzky and Kasparyan (2011) described a second genus of Collyriinae, *Aubertiella* Kuslitzky and Kasparyan, 2011, which we have not been able to include in the phylogenetic analyses here. Although excluded from the pimpliformes by Gauld (1997) and Wahl and Gauld (1998), *Collyria* shows some clear pimpliform apomorphies, such as the basally elongated propodeum, and clearly grouped with the pimpliformes in Quicke et al.'s (2009) combined morphological and molecular phylogenetic analyses. As the Collyriinae is a subfamily now containing only two genera, defined by some unusual character states within the Ichneumonidae, the current diagnosis of the subfamily was, until Kuslitzky and Kasparyan (2011), the diagnosis of the original genus, *Collyria*, and now requires reassessment with the addition of more plesiomorphic genera.

Two of the authors (M-LS and S-PS) received a single specimen of a distinctive ichneumonid collected in Jiangxi province, P.R. China. Unfortunately, further fieldwork by M-LS and S-PS in the type locality has failed to uncover any further specimens. This specimen proved very difficult to place in any subfamily, with a combination of character states that could almost equally feasibly place it in Poemeniinae or Collyriinae. For example, both subfamilies have an elongate propodeum with the spiracle only a little anterior to the middle; they both often lack transverse carinae on the propodeum; the hind coxa is elongate; the first metasomal segment is usually of a similar, elongate shape; the first abscissa of hind wing vein *cu* is much shorter than vein *cu-a*. This specimen, which obviously represents an undescribed species and genus, lacks the apomorphies of *Collyria*, namely the decurved ovipositor with small serrations along the lower margin and the distinctive claw characters (fore and mid tarsal claws each with a median tooth), although it does have lobate fore and mid claws, in common with several pimpliform taxa. The new specimen lacks the principle apomorphies of the Poemeniinae, namely the ventral continuation of the epomia parallel to the lower margin of the pronotum and the laterally expanded foramen magnum (although this is difficult to see in the single new specimen). As well as the character states that are common to Poemeniinae and *Collyria*, the new specimen shows three characters of

the head that led us to believe that its affinities are closer to *Collyria*, namely the short antennae, the presence of a bifurcate carina from the dorsal half of the face to between the antennae, and a weak median tubercle on the clypeus. After much deliberation, we hypothesised that this specimen represents a new genus of Collyriinae. To test this hypothesis, we coded the specimen of *Bicurta sinica* sp. n. and *Collyria coxator* (Villers) for Wahl and Gauld's (1998) morphological characters, to establish the position of these genera within the pimpliformes.

Materials and methods

For the phylogenetic analyses, codings were based on the matrix of Wahl and Gauld (1998) and on specimens in the Natural History Museum, London and in the Insect Museum, General Station of Forest Pest Management (GSFPM), State Forestry Administration, People's Republic of China (the holotype of *Bicurta sinica* sp. n.).

The character codings for *Bicurta* gen. n. and *Collyria* are shown in Table 1 with the character numbers as in Wahl and Gauld (1998). Given that these genera share some distinctive characters that were not included in Wahl and Gauld's analysis, two additional characters were included in our matrix.

Character 92. Dorsal face (0) lacking a bifurcate carina between the antennal sockets (Fig. 6); (1) possessing a bifurcate carina between the antennal sockets.

Character 93. Antenna length (0) normal, at least 0.8× length of fore wing; (1) short, only about 0.65-0.7× length of fore wing.

Both of these characters were coded as '0' for other taxa in Wahl and Gauld's (1998) matrix. For *Collyria*, characters of internal anatomy, ovipositor and larval morphology were taken from Quicke et al. (2009). Morphological terminology mostly

Table 1. Character codings for *Bicurta* and *Collyria*; characters 1-91 are from Wahl and Gauld (1998)

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Bicurta	1	2	0	1	0	0	0	0	0	?	?	1	1	0	0	1	0	0	0	?
Collyria	1	2	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
	21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
Bicurta	0	0	0	1	0	0	0	0	1	1	0	1	1	1	0	1	1	0	1	0
Collyria	0	0	0	1	0	0	0	0	0	0	0	1	1	1	0	0	1	0	1	0
	41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
Bicurta	0	0	1	0	1	n/a	0	1	1	0	1	1	0	1	0	0	0	0	0	0
Collyria	0	0	1	0	0	n/a	0	1	1	0	0	1	0	1	0	0	0	0	0	0
	61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
Bicurta	1	1	0	0	?	?	0	0	1	0	0	?	?	?	?	?	?	?	?	?
Collyria	1	0	0	0	0	0	0	0	1	0	0	0	?	1	0	0	2	0	0	0
	81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**							
Bicurta	?	?	?	?	?	?	?	?	?	?	?	1	1							
Collyria	?	?	1	0	1	0	0	?	1	?	0	1	1							

follows Gauld (1991). Morphological terms are linked to anatomical concepts in the Hymenoptera Anatomy Ontology (Yoder et al. 2010). URIs are provided in Table 2. Note that, at the time of writing, wing vein nomenclature and several other morphological terms used here have not yet been included in the HAO.

Table 2. Morphological characters and URIs to concepts in the Hymenoptera Anatomy Ontology.

Label	URI
abscissa	http://purl.obolibrary.org/obo/HAO_0000076
antenna, antennae	http://purl.obolibrary.org/obo/HAO_0000101
antennal sockets	http://purl.obolibrary.org/obo/HAO_0001022
anterior tentorial pits	http://purl.obolibrary.org/obo/HAO_0000126
apical teeth	http://purl.obolibrary.org/obo/HAO_0001681
area	http://purl.obolibrary.org/obo/HAO_0000146
areolet	http://purl.obolibrary.org/obo/HAO_0000147
bifurcate carina (upper face)	http://purl.obolibrary.org/obo/HAO_0001929
body	http://purl.obolibrary.org/obo/HAO_0000182
bulla	http://purl.obolibrary.org/obo/HAO_0000184
carina, carinae	http://purl.obolibrary.org/obo/HAO_0000188
clypeus	http://purl.obolibrary.org/obo/HAO_0000212
clypeal suture	http://purl.obolibrary.org/obo/HAO_0000126
clypeal fovea	http://purl.obolibrary.org/obo/HAO_0000126
edge	http://purl.obolibrary.org/obo/HAO_0000285
epicnemial carina	http://purl.obolibrary.org/obo/HAO_0000292
epomia	http://purl.obolibrary.org/obo/HAO_0000307
eye	http://purl.obolibrary.org/obo/HAO_0000217
face	http://purl.obolibrary.org/obo/HAO_0000502
first tergum	http://purl.obolibrary.org/obo/HAO_0000053
first sternum	http://purl.obolibrary.org/obo/HAO_0000035
flagellomere, flagellomeres	http://purl.obolibrary.org/obo/HAO_0000342
fore wing	http://purl.obolibrary.org/obo/HAO_0000351
fore tarsal claw	http://purl.obolibrary.org/obo/HAO_0001925
fourth flagellomere	http://purl.obolibrary.org/obo/HAO_0001896
frons	http://purl.obolibrary.org/obo/HAO_0001044
gena	http://purl.obolibrary.org/obo/HAO_0000371
glymma, glymmae	http://purl.obolibrary.org/obo/HAO_0000378
head	http://purl.obolibrary.org/obo/HAO_0000397
hind tarsal claw	http://purl.obolibrary.org/obo/HAO_0001927
hind coxa	http://purl.obolibrary.org/obo/HAO_0000587
hind femur	http://purl.obolibrary.org/obo/HAO_0001140
hind leg	http://purl.obolibrary.org/obo/HAO_0000399
hind tibia	http://purl.obolibrary.org/obo/HAO_0000631
hind wing	http://purl.obolibrary.org/obo/HAO_0000400
hypopygium	http://purl.obolibrary.org/obo/HAO_0000410
hypostomal carina	http://purl.obolibrary.org/obo/HAO_0000413

Label	URI
inner orbit	http://purl.obolibrary.org/obo/HAO_0001920
interocellar area	http://purl.obolibrary.org/obo/HAO_0000430
labial palpus	http://purl.obolibrary.org/obo/HAO_0000450
labrum	http://purl.obolibrary.org/obo/HAO_0000456
last visible tergum	http://purl.obolibrary.org/obo/HAO_0001508
last flagellomere	http://purl.obolibrary.org/obo/HAO_0000137
lateral lobe	http://purl.obolibrary.org/obo/HAO_0000466
lateral ocellus	http://purl.obolibrary.org/obo/HAO_0000481
lower ovipositor valve	http://purl.obolibrary.org/obo/HAO_0000339
malar space	http://purl.obolibrary.org/obo/HAO_0001393
mandible, mandibles	http://purl.obolibrary.org/obo/HAO_0000506
margin, margins	http://purl.obolibrary.org/obo/HAO_0000510
maxillary palp	http://purl.obolibrary.org/obo/HAO_0000515
median longitudinal suture of mesosternum	http://purl.obolibrary.org/obo/HAO_0000545
median longitudinal carina	http://purl.obolibrary.org/obo/HAO_0001929
mesopleuron	http://purl.obolibrary.org/obo/HAO_0000566
mesoscutum	http://purl.obolibrary.org/obo/HAO_0000575
mesosoma	http://purl.obolibrary.org/obo/HAO_0000576
mesosternum	http://purl.obolibrary.org/obo/HAO_0001710
metapleuron	http://purl.obolibrary.org/obo/HAO_0001271
metasoma	http://purl.obolibrary.org/obo/HAO_0000626
metasternum	http://purl.obolibrary.org/obo/HAO_0001931
mid lobe	http://purl.obolibrary.org/obo/HAO_0000520
mid tarsal claw	http://purl.obolibrary.org/obo/HAO_0001926
notaulus	http://purl.obolibrary.org/obo/HAO_0000647
notch	http://purl.obolibrary.org/obo/HAO_0000648
occipital carina	http://purl.obolibrary.org/obo/HAO_0000653
ocular ocellar line	http://purl.obolibrary.org/obo/HAO_0000662
ovipositor sheath	http://purl.obolibrary.org/obo/HAO_0000680
pleural carina	http://purl.obolibrary.org/obo/HAO_0000609
portion	http://purl.obolibrary.org/obo/HAO_0000146
postero-ocellar line	http://purl.obolibrary.org/obo/HAO_0000759
postscutellum	http://purl.obolibrary.org/obo/HAO_0000568
pronotum	http://purl.obolibrary.org/obo/HAO_0000853
propodeal spiracle	http://purl.obolibrary.org/obo/HAO_0000329
propodeum	http://purl.obolibrary.org/obo/HAO_0001249
pterostigma	http://purl.obolibrary.org/obo/HAO_0000957
puncture, punctures	http://purl.obolibrary.org/obo/HAO_0000885
sculpture	http://purl.obolibrary.org/obo/HAO_0000913
scutellum	http://purl.obolibrary.org/obo/HAO_0001229
second tergum	http://purl.obolibrary.org/obo/HAO_0000056
second valvula	http://purl.obolibrary.org/obo/HAO_0000928
segments	http://purl.obolibrary.org/obo/HAO_0001866
speculum	http://purl.obolibrary.org/obo/HAO_0000944
spiracle	http://purl.obolibrary.org/obo/HAO_0001538

Label	URI
sternaulus	http://purl.obolibrary.org/obo/HAO_0000953
sternum	http://purl.obolibrary.org/obo/HAO_0000955
sternum (second abdominal sternum)	http://purl.obolibrary.org/obo/HAO_0000035
submetapleural carina	http://purl.obolibrary.org/obo/HAO_0000974
subocular sulcus	http://purl.obolibrary.org/obo/HAO_0000504
tarsal claws	http://purl.obolibrary.org/obo/HAO_0000989
tegula	http://purl.obolibrary.org/obo/HAO_0000993
tentorial pits	http://purl.obolibrary.org/obo/HAO_0000999
tergite	http://purl.obolibrary.org/obo/HAO_0000053
tergum, terga	http://purl.obolibrary.org/obo/HAO_0001349
tergum	http://purl.obolibrary.org/obo/HAO_0000053
tergum 3	http://purl.obolibrary.org/obo/HAO_0000057
tergum 6	http://purl.obolibrary.org/obo/HAO_0000060
tooth, teeth	http://purl.obolibrary.org/obo/HAO_0001019
tooth	http://purl.obolibrary.org/obo/HAO_0001219
tooth	http://purl.obolibrary.org/obo/HAO_0001681
third tergum	http://purl.obolibrary.org/obo/HAO_0000057
transverse carina (propodeum)	http://purl.obolibrary.org/obo/HAO_0001930
trochantellus of hind leg	http://purl.obolibrary.org/obo/HAO_0001859
trochanter of hind leg	http://purl.obolibrary.org/obo/HAO_0001139
tubercle	http://purl.obolibrary.org/obo/HAO_0001036
upper face	http://purl.obolibrary.org/obo/HAO_0001044
upper tooth (mandible)	http://purl.obolibrary.org/obo/HAO_0000276
vertex	http://purl.obolibrary.org/obo/HAO_0001077
wing	http://purl.obolibrary.org/obo/HAO_0001089
wing venation	http://purl.obolibrary.org/obo/HAO_0001096

We have also made some changes to the character codings employed by Wahl and Gauld (1998). Wahl and Gauld's character 45 (number of bullae in fore wing vein 2*m-cu*) was re-coded for Agriotypinae (changed to '1') and for Labeninae (to polymorphic), following Bennett (2001); their character 46 (shape of the areolet) has been re-coded as '?', rather than '0', for taxa lacking fore wing vein 3*rs-m*. Following Matsumoto and Broad (2011), *Rodrigama* Gauld has been re-coded for character 19 (occipital carina is dorsally incomplete), 26 (epicnemial carina is present) and 34 (hind coxa is elongate). Note that *Rossemia* Humala is the valid name for Wahl and Gauld's *Sweaterella* (Humala, 2003).

Phylogenetic analyses were carried out in TNT 1.1 (Goloboff et al. 2003), with all characters unordered and using default settings except for the following (as employed by Burks et al. 2011): ratchet weighting probability (up and down) of 5%, 200 iterations, drift of 50 cycles, tree fusing of five rounds, and find minimum length 25 times. Phylogenetic trees were edited in Winclada (Nixon 1999).

SEM images of uncoated specimens were taken using a Leo 1455VP low vacuum scanning electron microscope. Photographs of *Bicurta sinica* sp. n. were taken using a

Canon Power Shot A650 IS and Cool Snap 3CCD attached to a Zeiss Discovery V8 Stereomicroscope and captured with QCapture Pro version 5.1.

Results

Phylogenetic analyses

With characters unordered and unweighted, 12 trees of length 240 were found; the strict consensus is shown in Fig. 1. The relationships betweeen subfamilies are largely unresolved but *Bicurta* and *Collyria* are recovered as a clade, as are all other subfamilies with multiple representatives, except Cylloceriinae. Searching with implied weights of values ranging from k=1 to k=10 resulted in a single topology, shown in Fig. 2. This phylogeny is similar to that obtained by Wahl and Gauld (1998), except that Xoridinae shift to the sister group of the labeniformes plus ichneumoniformes and the genera of Poemeniinae are fully resolved. *Bicurta*+*Collyria* are recovered as a clade and as the sister group to Rhyssinae. As a test of the robustness of the results, characters 72 to 93 (which include both those characters missing for a large number of taxa and the two additional characters included in this study) were excluded and the analysis run using the same parameters. The topology of Collyriinae, Rhyssinae and Poemeniinae remained the same, although relationships within the remaining pimpliformes collapsed in the strict consensus (Fig. 3).

In these analyses, the monophyly of Collyriinae is attested by numerous homoplasies and two synapomorphies: the presence of a bifurcate carina on the upper face extending to between the antennal sockets and the short antennae. The sister group relationship of Collyriinae to Rhyssinae was unexpected and is supported by a single apomorphy, the absence of the posterior transverse carina of the propodeum. The monophyly of Poemeniinae+Rhyssinae+Collyriinae is again weakly supported by one unambiguous apomorphy (the small and subrectangular clypeus) and two homoplasies (hind wing vein 2/*Cu* originating close to vein *M* and the elongate last visible tergite of the female). In contrast, Quicke et al. (2009), in their combined morphological and molecular analyses, found *Collyria* to nest within the Diptera-parasitizing clade of pimpliformes, in a topology that seemed to be overwhelmingly influenced by the morphology dataset.

Definition of Collyriinae

The Collyriinae, now comprising the genera *Aubertiella*, *Bicurta* gen. n. and *Collyria*, can be defined by the following characters, based on the phylogenetic analyses presented here and on the description of *Aubertiella* (Kuslitzky and Kasparyan 2011), although only the first two are autapomorphic for the subfamily: dorsal part of face with bifurcate carina extending between antennal sockets (character not mentioned

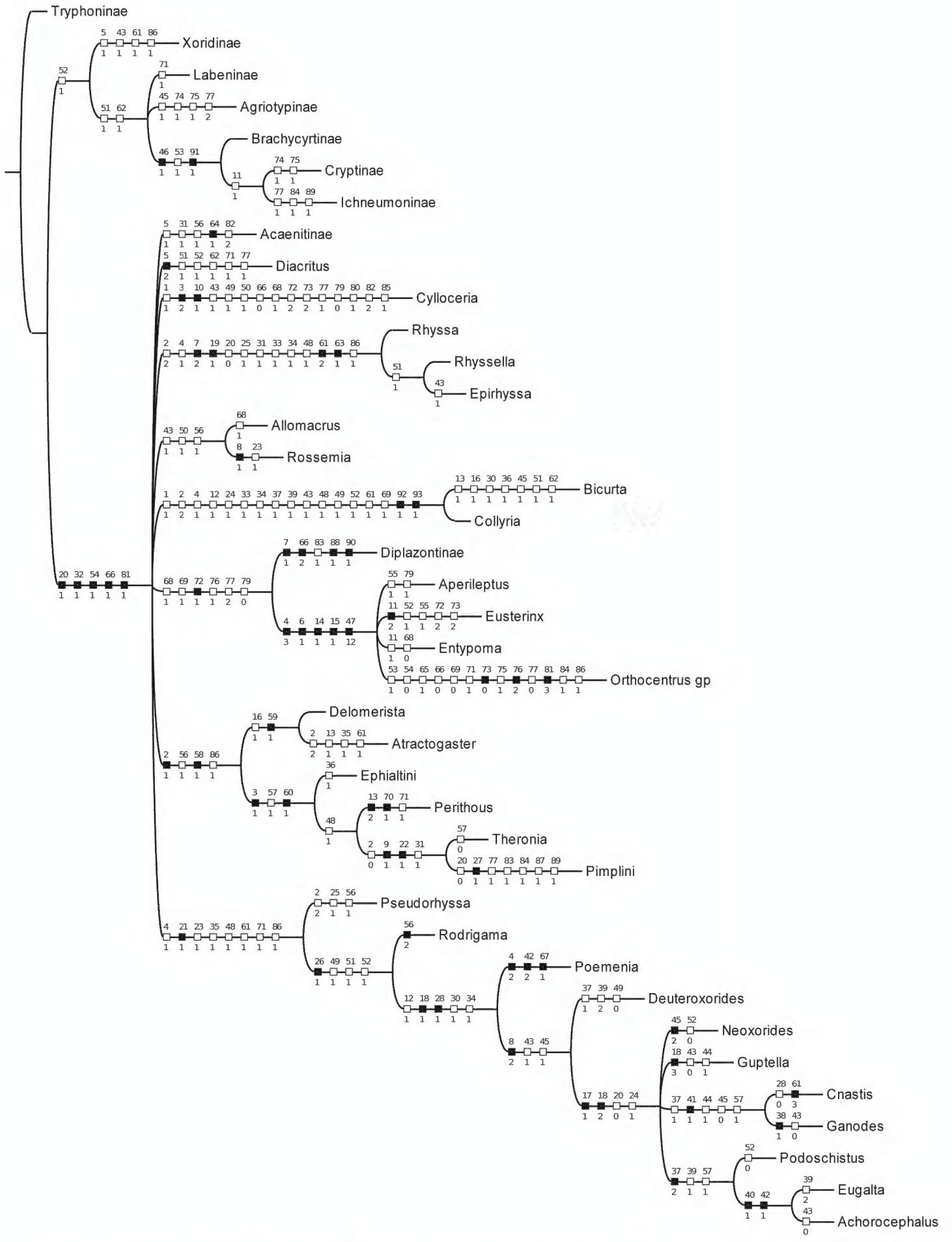

Figure 1. Cladogram of selected pimpliformes taxa. Strict consensus of 12 trees of length 240. Apomorphic characters are indicated by black squares, homoplasies by white squares.

by Kuslitzky and Kasparyan 2011); antennae short; clypeus with median tubercle; posterior transverse carina of propodeum absent; hind coxa elongate; fore and mid claws with teeth; fore wing vein *3rs-m* absent; hind wing vein *Cu*1 much closer to vein

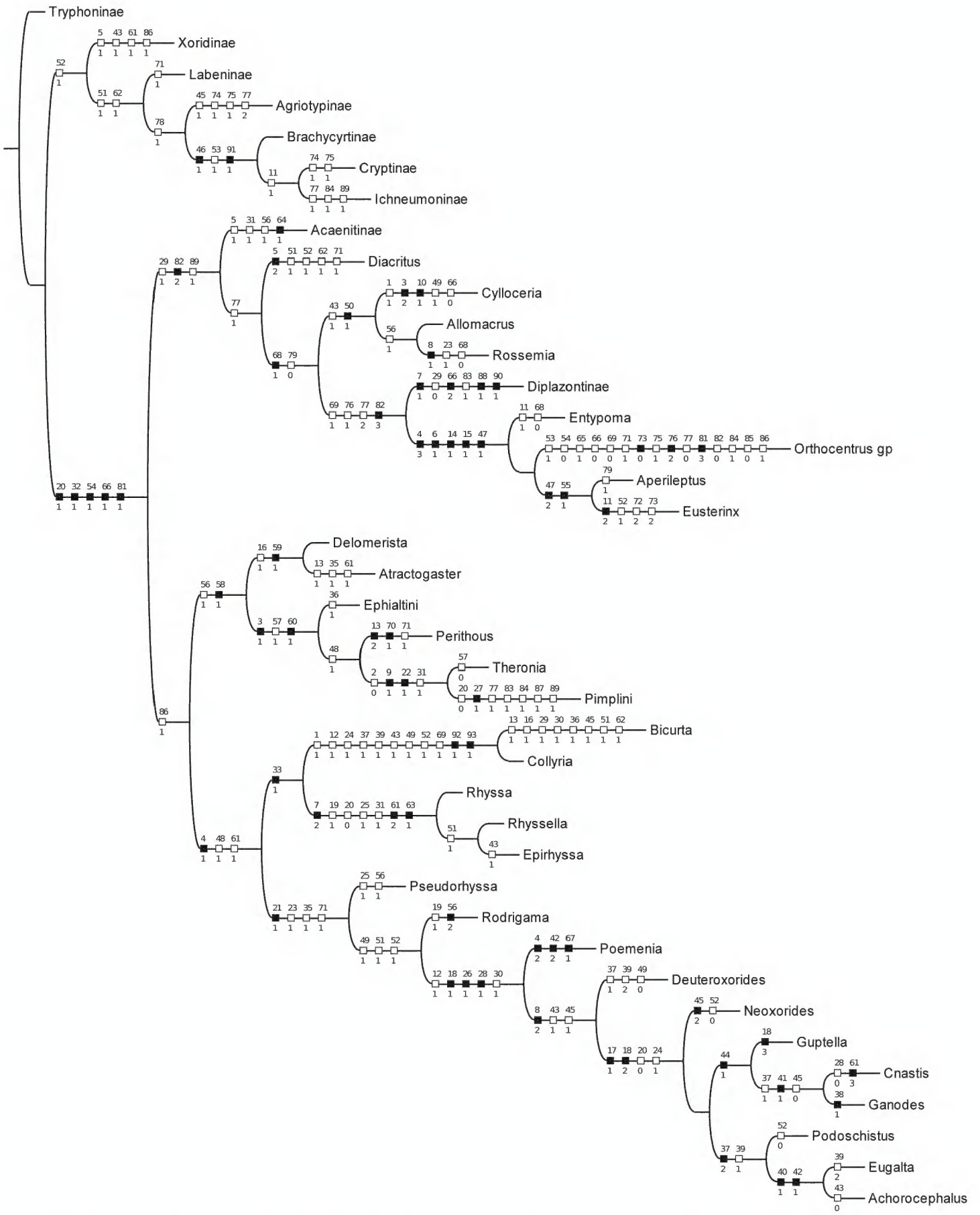

Figure 2. Cladogram of selected pimpliformes taxa obtained by reweighting with implied weights, k=3.

M than to *A*; first tergite lacking longitudinal carinae; glymmae absent; last visible tergite of female elongate (apparently only an apomorphy of *Bicurta* and *Collyria*, not *Aubertiella* – Kuslitzky and Kasparyan 2011); and the ovipositor lacking ventral, apical teeth. The monophyly of *Collyria* is attested to by an autapomorphy not included in the analysis: the ventral ovipositor valve is weakly serrate along the median ~0.5 (which we contend are not 'teeth' as usually defined in the Ichneumonoidea as they are

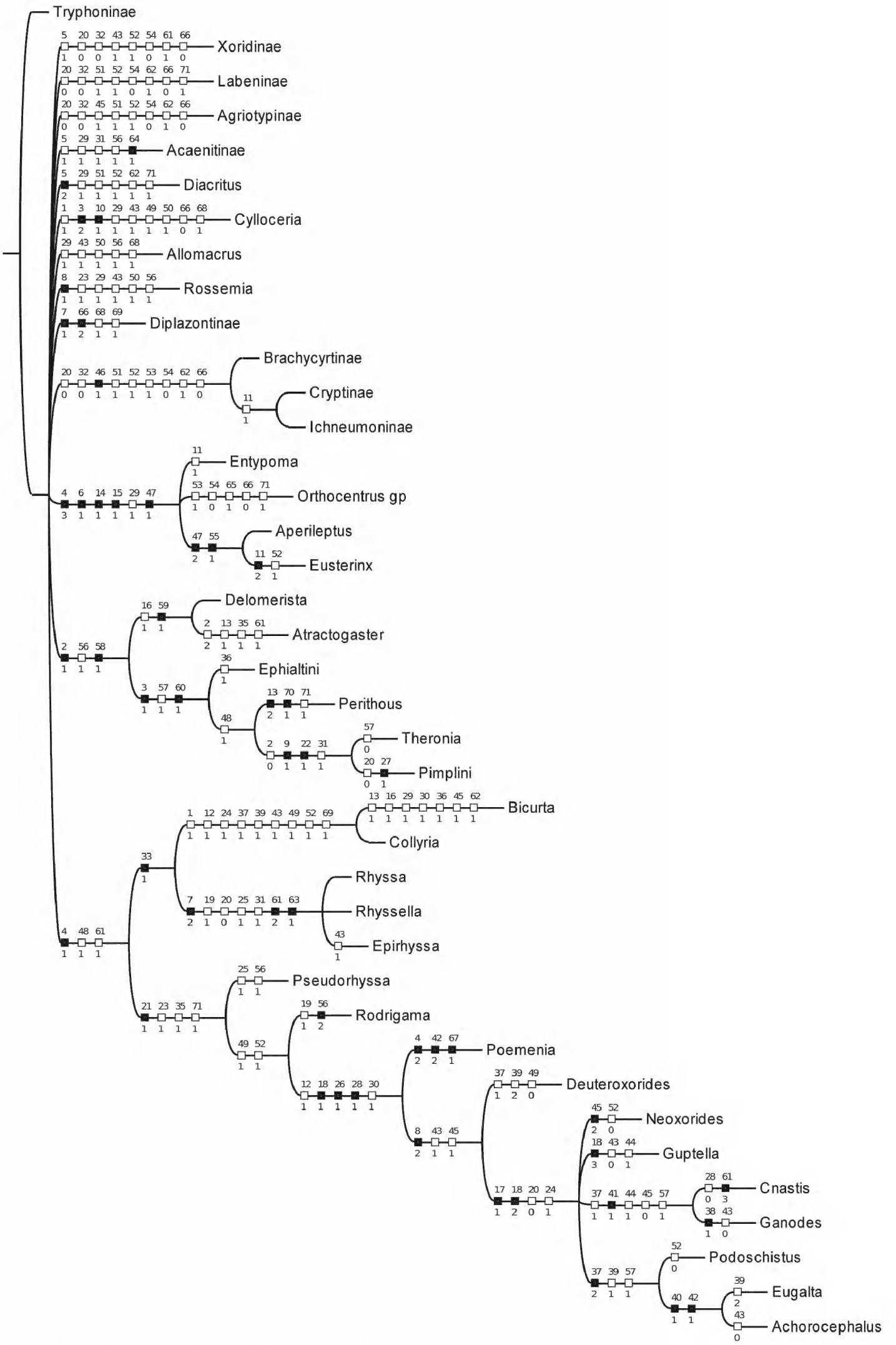

Figure 3. Strict consensus of 89 trees resulting from analysis of reduced data matrix (characters 72–93 excluded).

not ridges across the depth of the apical part of the lower valve). The monophyly of *Bicurta* is supported by some rather weak characters, including the pale markings on the face and malar space; the more posteriorly displaced propodeal spiracle (compared to *Collyria*); the large, lobe-like teeth on the fore and mid tarsal claws (which may be plesiomorphic with respect to the narrower teeth of *Collyria*); fore wing vein 2*m-cu* with one bulla; the first tergite and sternite fused; and the first sternite more than half the length of the tergite.

An expanded phylogenetic matrix, encompassing the genera of Acaenitinae, could reveal some rather different patterns of relationships within the pimpliformes. Several acaenitine genera share character states with collyriines and some poemeniines, such as short antennae, a median tubercle on the clypeus, hind wing vein *Cu*1 originating close to *M* and the propodeum lacking transverse carinae. However, acaenitines have a distinctive apomorphic female hypopygium, very different to that of the Collyriinae, Poemeniinae or Rhyssinae.

Taxonomy

Collyriinae Cushman
http://species-id.net/wiki/Collyriinae

Diagnosis. Collyriinae can be distinguished from all other subfamilies of Ichneumonidae by the following combination of characters: 1) dorsal part of face with a bifurcate carina extending between the antennal sockets and 2) antenna short, only slightly longer than combined length of head and mesosoma, 0.65–0.7× length of fore wing. Additional distinctive characters, in combination (individually, all are shared with other taxa) are the elongate propodeum with strong lateromedian longitudinal carinae, very stout hind femur, elongate hind coxa and the subclavate shape of the metasoma.

As the concept of Collyriinae has now been expanded since Townes's (1971) definition, we provide a modified description of the subfamily below.

Description. Antenna short, c. 0.65–0.7× length of fore wing. Male flagellum without tyloids. Mesosoma subcylindric. Occipital carina complete, evenly arched dorsally. Ventrally reaching hypostomal carina well behind base of mandible. Dorsal part of face with a bifurcate carina extending between antennal sockets. Clypeal suture vestigial between clypeal foveae, clypeus faintly convex, apical margin with median tooth or protruberance. Basal portion of mandible wider, strongly narrowed toward apex, teeth sharp, teeth subequal or lower tooth longer than upper tooth. Maxillary palpus with 5 segments, labial palpus with 4 segments. Foramen magnum not expanded laterally. Anterior slope of mid lobe of mesoscutum approximately vertical. Epomia absent. Notaulus long. Epicnemial carina present. Postpectal carina incomplete. Propodeum long, rather cylindrical, longitudinal carinae developed to varying degrees, transverse carinae absent, juxtacoxal carina absent, propodeal spiracle oval. Apex of fore tibia without a tooth on outer side. Fore and hind tibiae each with two spurs. Fore

and mid tarsal claws each with either tooth at mid-length or basal lobe, hind tarsal claw large, simple, strongly curved. Hind femur stout, 3.0–3.6× as long as maximally deep. Metasoma subclavate, weakly laterally compressed in distal half. First metasomal segment long, narrow, spiracles anterior to middle, sclerotized part of first sternum extending to middle of tergite or anterior to this. Last visible tergite usually elongate. Hypopygium not elongate. Ovipositor slightly to markedly decurved. Fore wing vein 1*cu-a* opposite 1/*M*, vein 3*rs-m* absent. Hind wing with abscissa of *Cu* between *M+Cu* and *cu-a* strongly reclivous, about 0.2× as long as *cu-a*.

Biology. *Collyria coxator* (Villers) is a common parasitoid of *Cephus pygmaeus* (Linnaeus) (Hymenoptera: Cephidae) in Europe and a detailed account of its life history was published by Salt (1931). Another species of *Collyria*, *C. catoptron* Wahl, has been reared from *Cephus fumipennis* Eversmann (Wahl et al. 2007). Little is known about the biology of other species but they are likely to all be parasitoids of Cephidae. The biology of the genus is unusual for Ichneumonidae in that oviposition is into the host egg with emergence from the fully grown host larva after it has spun its cocoon (Salt 1931). Nothing is known of the biology of *Bicurta sinica* sp. n. or of *Aubertiella nigricator* (Aubert 1964).

Geographic range. The nine described *Collyria* species are found across the Palaearctic, although with few published records from the Eastern Palaearctic (Yu et al. 2009). *Collyria coxator* was introduced to Canada (Saskatchewan) (Smith 1931) in an unsuccessful (Carlson 1979) attempt to control the native *Cephus cinctus* Norton. However, it does seem to have become established in North America as a parasitoid of the introduced *Cephus pygmaeus* (Filipy et al. 1985). *Aubertiella nigricator* is known from Israel and Syria (Kuslitzky and Kasparyan 2011).

Included species. *Aubertiella nigricator* (Aubert, 1964) (originally described in *Collyria*), *Collyria catoptron* Wahl, 2007; *Collyria coxator* (Villers, 1789); *Collyria distincta* Izquierdo & Rey del Castillo, 1985; *Collyria fuscipennis* (Kriechbaumer, 1894); *Collyria iberica* Schmiedeknecht, 1908; *Collyria isparta* Gurbuz & Kolarov, 2006; *Collyria orientator* Aubert, 1979; *Collyria sagitta* Kuzin, 1950; *Collyria trichophthalma* (Thomson, 1877); and *Bicurta sinica* sp. n.

Bicurta Sheng, Broad & Sun, gen. n.

urn:lsid:zoobank.org:act:82873255-27E4-4CD0-9742-524EED50BF7B
http://species-id.net/wiki/Bicurta

Type species. *Bicurta sinica* Sheng, Broad & Sun, sp. n.

Diagnosis. *Bicurta* can be distinguished from *Collyria* by any of the following characters (state in *Collyria* in brackets: 1) epicnemial carina not clearly visible dorsal to mesosternum (carina distinct on mesopleuron); 2) ovipositor straight and smooth, without teeth on ventral valve (weakly decurved with weak teeth on ventral valve in most species; 3) fore and mid tarsal claws with acutely lobed tooth (with a weak medial tooth). *Aubertiella* resembles *Bicurta* in the very weak clypeal tubercle and simple ovi-

positor but can be distinguished by the median teeth on the fore and mid tarsal claws (similar to *Collyria*), black face and the apical tergites retracted beneath the sixth tergite.

Description. Clypeus nearly flat in lateral view, about 2.2 × as wide as high in anterior view (Fig. 10), median section of apical margin almost truncate, with an obtuse median tubercle or angulation. Mandible strongly narrowed toward apex, teeth sharp, lower tooth slightly longer than upper tooth. Dorsal part of face with bifurcate carina that extends between antennal sockets (Fig. 6a). Antenna short, 0.66x fore wing length, almost clubbed. Notaulus deep, reaching to middle of mesoscutum level with posterior margin of tegula (Fig. 11b). Epicnemial carina indistinct, not clearly visible dorsal to mesosternum (Fig. 11a) although slight furrow can be traced dorsally, far posterior to front edge of mesopleuron. Sternaulus vestigial on anterior 0.4 of mesopleuron. Scutellum and postscutellum approximately flat. Anterior section of submetapleural carina vestigial. Areolet absent. Fore wing with vein 1*cu-a* opposite 1/*M*; 2*m-cu* slightly inclivous, with one bulla. Hind wing with abscissa of *Cu* between *M+Cu* and *cu-a* much longer than *cu-a* (*Cu*1 originating close to vein *M*). Fore and mid tarsal claws elongate with acutely lobed tooth (Fig. 8a). Hind tarsal claw simple (Fig. 8b). Hind coxa elongate, almost as long as first tergite. Hind femur stout, 3.3x as long as maximally deep. Hind leg particularly long, in total 1.9x length of fore wing. Hind coxa elongate, about 0.8 × as long as hind femur, Propodeum elongate, with complete longitudinal carinae, median longitudinal carinae slightly convergent posteriorly, without transverse carinae (Fig. 5a). Propodeal spiracle obliquely elliptical, located at about mid-length of propodeum. Basal portion of metasoma narrow and elongate, apical portion laterally compressed. First tergum approximately 5 × as long as apical width, without longitudinal carinae; sternum reaching half length of tergum, fused with tergum; without glymma; spiracle located at basal 0.42. Ovipositor smooth, without teeth on ventral valve (Fig. 9). Otherwise as in the description of the subfamily.

Etymology. The name of the new genus is based on the short antenna and ovipositor sheath. The gender is feminine.

Bicurta sinica Sheng, Broad & Sun, sp. n.

urn:lsid:zoobank.org:act:5A7C89FD-5BD7-4574-81F0-4517B3B7FCD6
http://species-id.net/wiki/Bicurta_sinica
Figs 4–11

Material examined. Holotype female, CHINA: Guanshan, 430 m, Yifeng County, Jiangxi Province, 20 April 2009, leg. Ling-Li Yi and Yi Li (GSFPM).

Description. Habitus: Fig. 4. Female. Body length 10.5 mm. Fore wing length 7.6 mm. Ovipositor length about 1.5 mm.

Head. Face approximately flat, 1.4 × as wide as long, with even punctures, distance between punctures 0.2 to 1.0 × diameter of puncture, lateral sides (inner orbit) impunctate and with fine granular texture. Clypeus nearly flat, about 2.2 × as wide as long, with fine, sparse punctures, distance between punctures 2 to 4 × diameter of

Figure 4. *Bicurta sinica* Sheng, Broad & Sun, sp. n., habitus.

puncture, apical portion smooth, impunctate. Labrum crescentic, about 0.33 × as long as wide. Malar space with fine leathery texture, without subocular sulcus, approximately 0.4 × as long as basal width of mandible. Gena glossy, with distinct fine punctures, in lateral view approximately 0.66 × as long as width of eye, evenly convergent backward. Posterior portion of vertex with fine punctures, portion between lateral ocellus and eye with fine leathery texture. Interocellar area slightly convex, with fine longitudinal wrinkles. Postero-ocellar line approximately as long as ocular-ocellar line. Dorsolateral part of frons with fine punctures, distance between punctures about as long as diameter of puncture; median portion narrowly smooth longitudinally; ventral portion with weak median longitudinal carina reaching to median protuberance of face. Antenna 5 mm, with 20 flagellomeres, ratio of length of flagellomere 1:2:3:4:5 is 5.5:4.0:3.8:3.7:3.4; last flagellomere 3 × as long as wide, approximately as long as fourth flagellomere. Distance from hypostomal carina to mandible about as long as basal width of mandible.

Mesosoma. Anterior portion of pronotum with fine longitudinal wrinkles; dorsal portion slightly scabrous; near dorsomedian portion with transverse wrinkles, posterior sections of the wrinkles parallel dorsal margin of pronotum; ventral portion with dense transverse wrinkles. Epomia indistinctly differentiated from strong oblique wrinkles. Mesoscutum with fine punctures; punctures on middle lobe denser than on lateral lobe, distance between punctures 0.2 to 2.5 × diameter of puncture; distance between punctures on lateral lobe 0.5 to 3.5 × diameter of puncture; posterior median portion with longitudinal concave and transverse wrinkles. Scutellum with dense punctures, distance between punctures 0.2 to 0.5 × diameter of puncture. Postscutellum with rela-

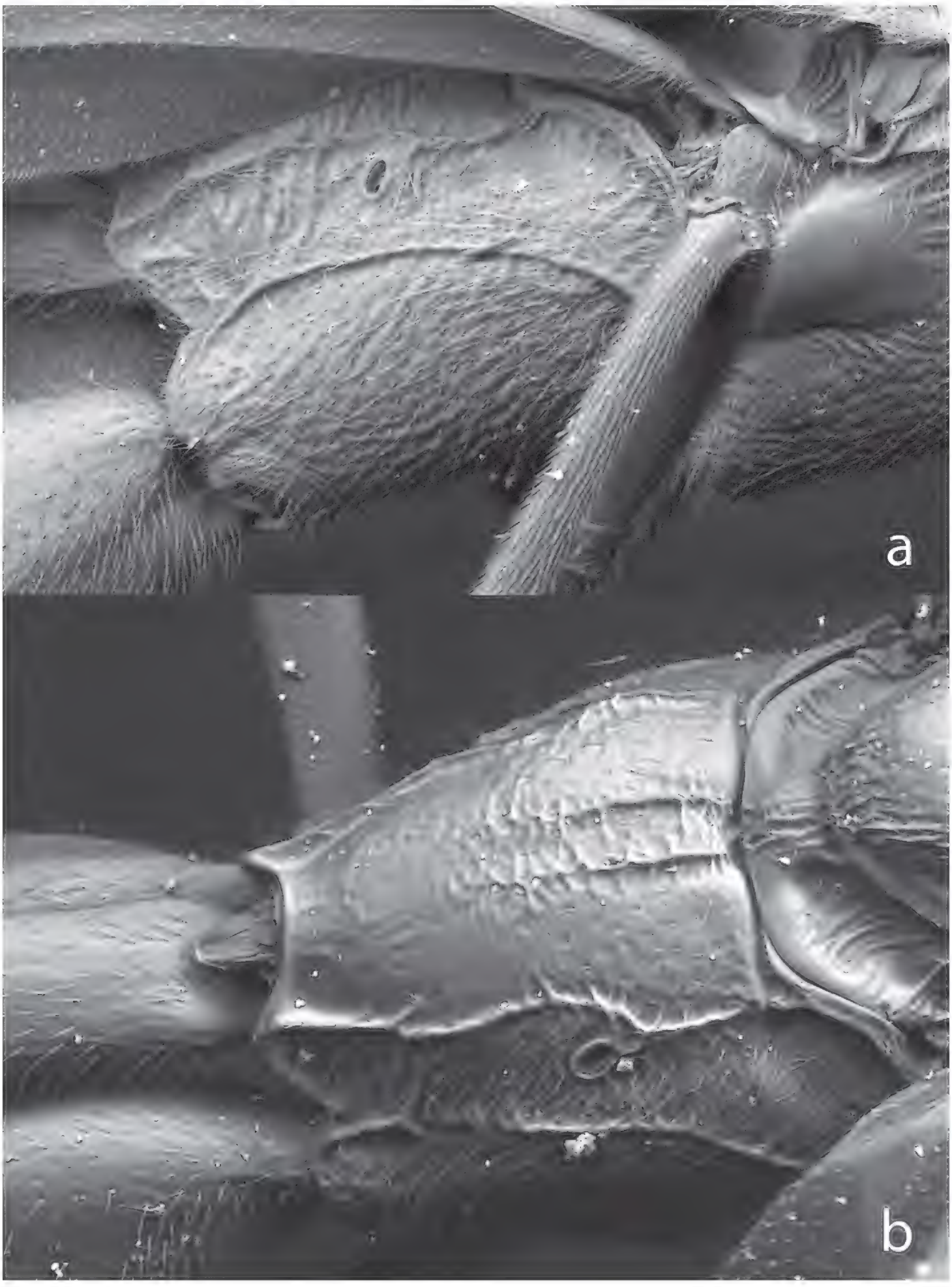

Figure 5. Propodeum of *Bicurta sinica* **a** and *Collyria coxator* **b**. Figs **5–9**, SEMs of uncoated specimens.

tively large, elongate punctures. Lower portion of mesopleuron slightly scabrous, with dense punctures; dorsoanterior portion, in front of subalar prominence, with short longitudinal wrinkles; median portion (anterior to speculum) and ventroposterior por-

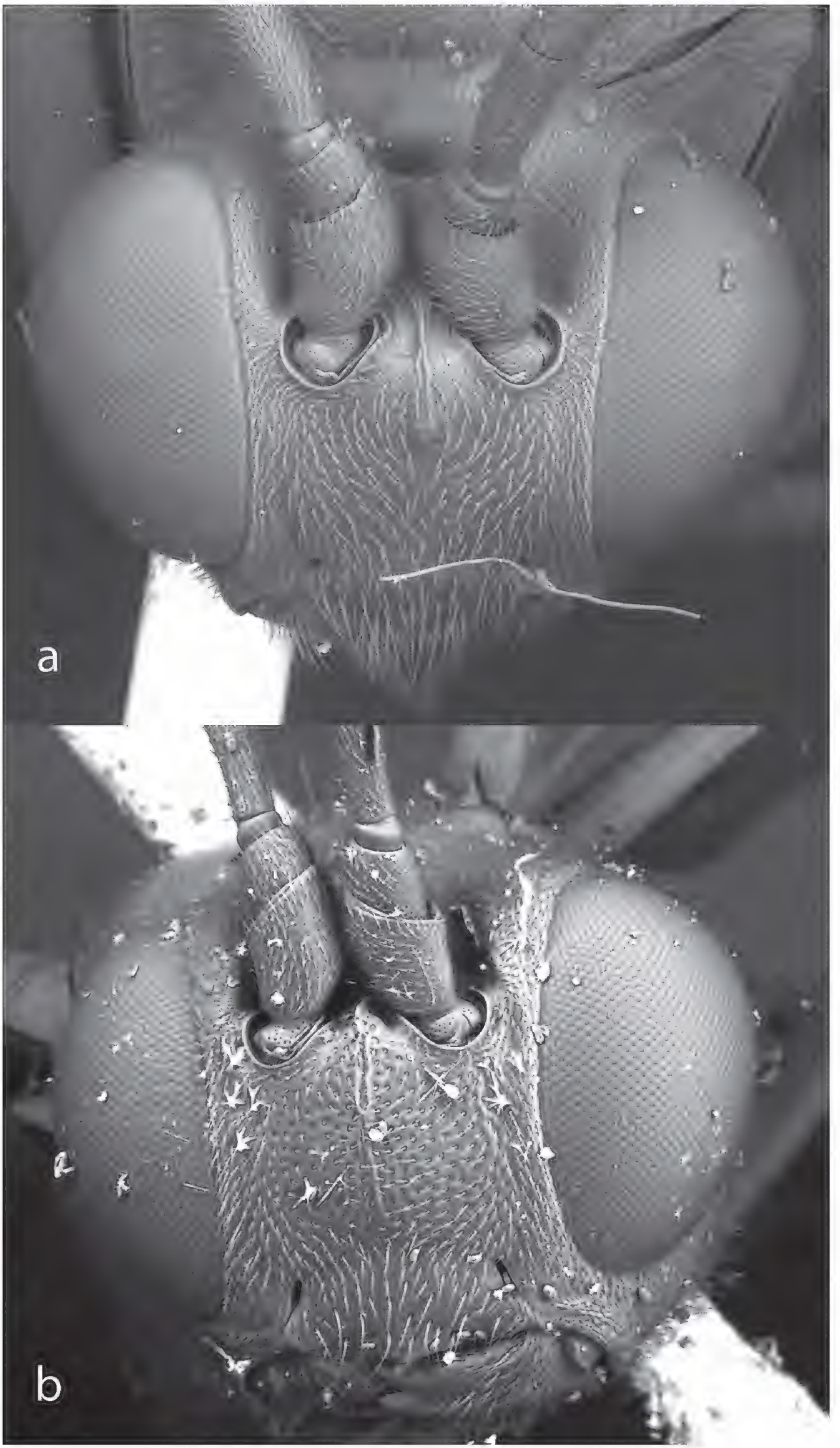

Figure 6. Head, frontal view, of *Bicurta sinica* **a** and *Collyria coxator* **b**.

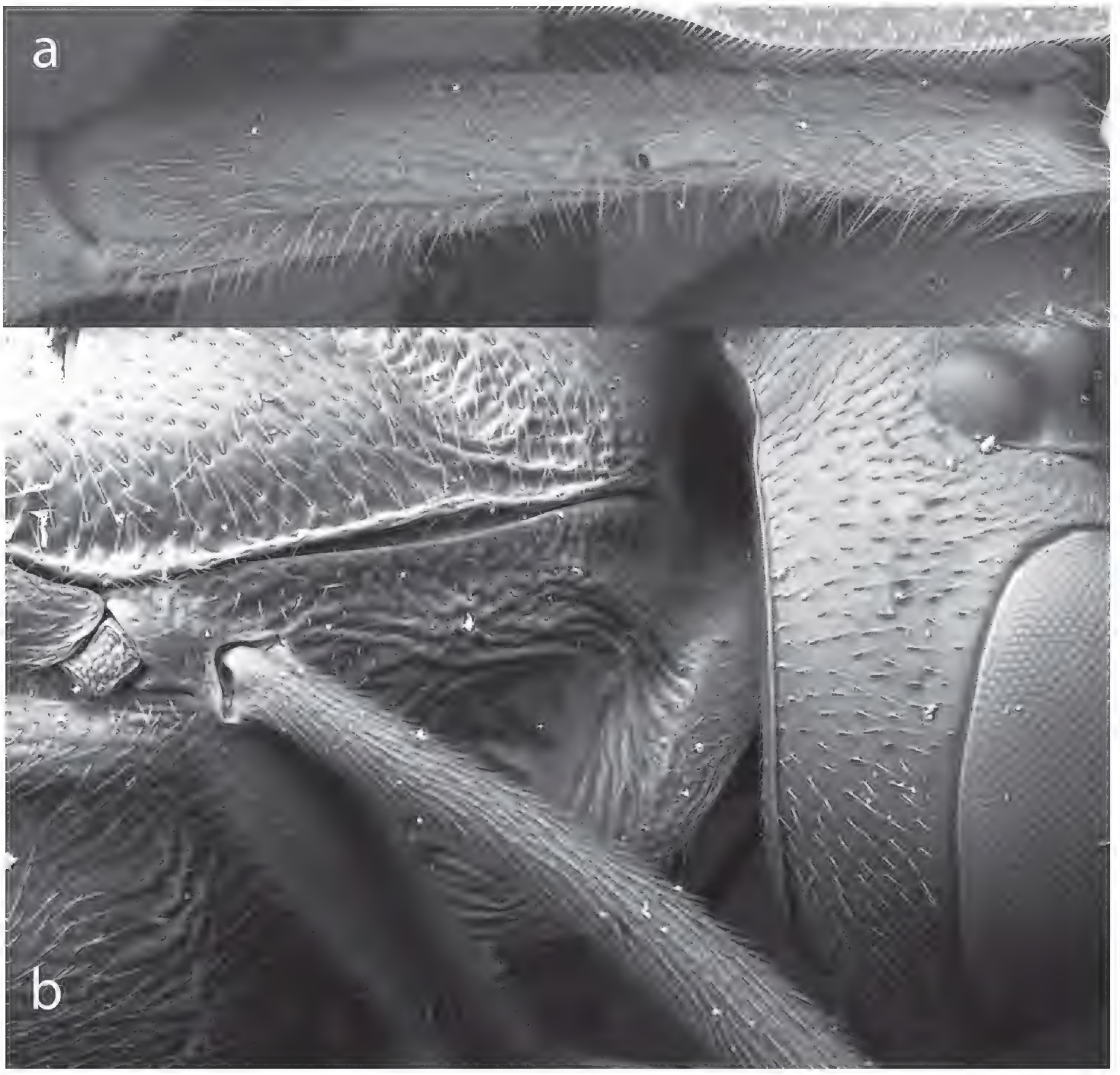

Figure 7. First tergite **a** and pronotum **b** of *Bicurta sinica*.

tion with short transverse wrinkles. Speculum relatively large. Mesosternum densely punctate. Median longitudinal suture of mesosternum distinct, slightly widening posteriorly. Metapleuron scabrous, with irregular, elongate punctures. Metasternum elongate, approximately 0.6 × as long as mesosternum, with distinct median longitudinal carina and irregular transverse wrinkles. Wing hyaline with slight grey tinge. 2*rs-m* basad 2*m-cu* by 0.66 × length of 2*rs-m*. Vein 2-*Cu* as long as 2*cu-a*. Hind coxa with distinct punctures. Ratio of length of hind tarsomeres 1:2:3:4:5 is 10.0:4.2:2.9:2.0:4.2. Propodeum between carinae with distinct transverse wrinkles. Propodeal spiracle 1.4 × as long as maximum width, distance to pleural carina approximately 2.6 × as long as distance to lateral longitudinal carina.

Metasoma. First tergum approximately 5 × as long as apical width, with longitudinal wrinkles, between wrinkles with punctures; without longitudinal carina; spiracle convex, located at basal 0.42. Second tergum about 2.0 × as long as apical width, slightly widened posteriorly, with sparse, indistinct punctures. Third tergum with even,

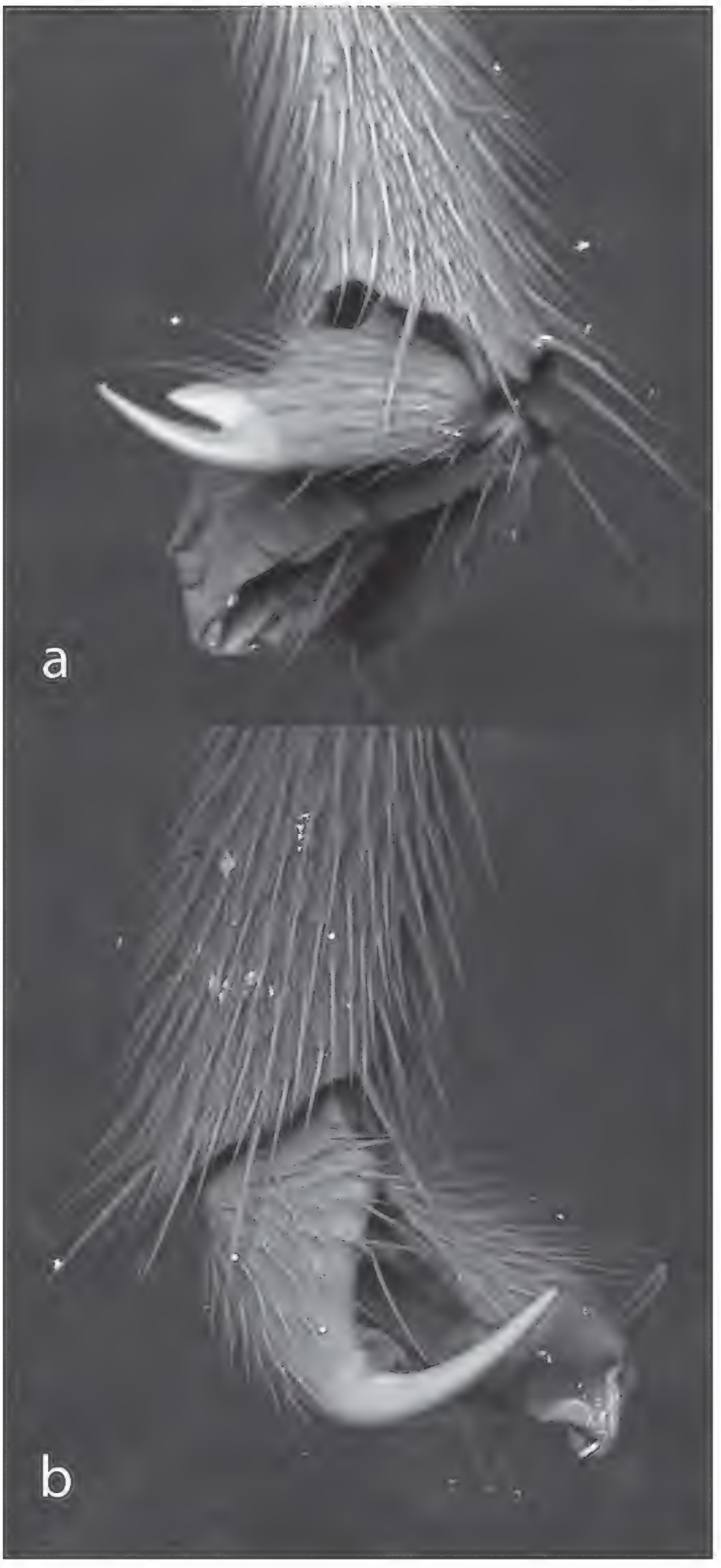

Figure 8. Fore claw **a** and hind claw **b** of *Bicurta sinica*.

Figure 9. Ovipositor of *Bicurta sinica*.

Figure 10. Face of *Bicurta sinica*.

Figure 11. Mesopleuron **a** and mesoscutum **b** of *Bicurta sinica*.

fine hairs, gradually weaker and indistinct posteriorly. Ovipositor sheath about 0.27 × as long as hind tibia. Ovipositor very slightly compressed.

Colour. Black. Ventral, inner orbits, clypeus, stripe passing through anterior tentorial pits, mandible except teeth, yellow; ventral profile of antenna brown to yellowish brown. Labial and maxillary palpi, fore and mid legs, trochantellus of hind leg, hind tarsomeres buff. Apex of hind coxa, ventral profile of trochanter of hind leg, basal and apical portion of hind femur brown. Basal 0.65 of hind tibia dull yellow, fading to dark brown apical 0.35. Tegula dark brown. Hind margins of terga 3 to 6 narrowly yellow. Wing venation, including pterostigma dark brown.

Etymology. Named after the country, China, where the unique specimen was collected.

Diagnosis. A distinctive species with the short, featureless ovipositor, rather massive hind leg, lobate fore and mid claws, short antennae and well-marked facial pattern.

Discussion

Unfortunately, nothing is known of the biology of *Bicurta sinica* sp. n. Where known, species of *Collyria* are koinobiont egg-larval endoparasitoids of stem-sawflies (Hymenoptera: Cephidae) (Salt 1931; Wahl et al. 2007). This is an unusual strategy within Ichneumonidae and presumably accounts for the distinctive ovipositor of *Collyria*; slender, lacking apical teeth or a notch but with serrations on the lower valves for cutting through grass stems. The slender, featureless ovipositor of *Bicurta* could well be indicative of oviposition into insect eggs, but this must remain as speculation for now.

An expanded phylogenetic matrix, encompassing the genera of Acaenitinae, could reveal some rather different patterns of relationships within the pimpliformes. Several acaenitine genera share character states with collyriines and some poemeniines, such as short antennae, a median tubercle on the clypeus, hind wing vein *Cu*1 originating close to *M* and the propodeum lacking transverse carinae, and it is interesting that various older authors included *Collyria* within the Acaenitinae (or equivalent grouping). Obviously, acaenitines have a distinctively apomorphic female hypopygium, very different to that of the Collyriinae, Poemeniinae or Rhyssinae.

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References

Bennett AMR (2001) Phylogeny of the Agriotypinae (Hymenoptera: Ichneumonidae), with comments on the subfamily relationships of the basal Ichneumonidae. Systematic Entomology 26: 329–356. doi: 10.1046/j.0307-6970.2001.00155.x

Burks RA, Heraty JM, Gebiola M, Hansson C (2011) Combined molecular and morphological phylogeny of Eulophidae (Hymenoptera: Chalcidoidea), with focus on the subfamily Entedoninae. Cladistics 27: 1–25. doi: 10.1111/j.1096-0031.2011.00358.x

Carlson RW (1979) Family Ichneumonidae. In: Krombein KV, Hurt PD, Smith DR, Burks BD (Eds) Catalog of Hymenoptera in America north of Mexico, Washington, 315–740.

Filipy FL, Burbutis PP, Fuester RW (1985) Biological control of the European wheat stem sawfly in Delaware (Hymenoptera: Cephidae). Environmental Entomology 14: 665–668.

Gauld ID (1985) The phylogeny, classification and evolution of parasitic wasps of the subfamily Ophioninae (Ichneumonidae). Bulletin of the British Museum (Natural History), Entomology 51: 61–185.

Gauld ID (1991) The Ichneumonidae of Costa Rica, 1. Memoirs of the American Entomological Institute 47: 1–589.

Gauld ID (1997) The Ichneumonidae of Costa Rica, 2. Memoirs of the American Entomological Institute 57: 1–485.

Gauld ID, Wahl DB (2006) The relationship and taxonomic position of the genera *Apolophus* and *Scolomus* (Hymenoptera: Ichneumonidae). Zootaxa 1130: 35–41.

Goloboff P, Farris J, Nixon K (2003) T.N.T.: Tree Analysis Using new Technology. Program and documentation, avaible from the authors, and at www.zmuc.dk/public/phylogeny/TNT (November 2009).

Humala AE (2003) [The Ichneumonid Wasps in the Fauna of Russia and Adjacent Countries: Microleptinae and Oxytorinae (Hymenoptera: Ichneumonidae)] Nauka, Moscow. [In Russian]

Kuslitzky VS, Kasparyan DR (2011) A new genus of ichneumonid flies of the subfamily Collyriinae (Hymenoptera: Ichneumonidae) from Syria and Israel. Zoosystematica Rossica 20: 319–324.

Matsumoto R, Broad GR (2011) Discovery of *Rodrigama* Gauld in the Old World, with description of two new species (Hymenoptera, Ichneumonidae, Poemeniinae). Journal of Hymenoptera Research 20: 65–75. doi: 10.3897/jhr.29.872

Nixon KC (1999) Winclada (BETA) ver. 0.9.9. Published by the author, Ithaca, N.Y.

Quicke DLJ, Laurenne NM, Fitton MG, Broad GR (2009) A thousand and one wasps: a 28S rDNA and morphological phylogeny of the Ichneumonidae (Insecta: Hymenoptera) with an investigation into alignment parameter space and elision. Journal of Natural History 43: 1305–1421. doi: 10.1080/00222930902807783

Salt G (1931) Parasites of the wheat-stem sawfly, *Cephus pygmaeus* Linnaeus, in England. Bulletin of Entomological Research 22: 479–545. doi: 10.1017/S0007485300035355

Smith CW (1931) Colonisation in Canada of *Collyria calcitrator* (Hym. Ichn.), a parasite of the wheat sawfly. Bulletin of Entomological Research 22: 547–550. doi: 10.1017/S0007485300035367

Townes HK (1971) Genera of Ichneumonidae Part IV. Memoirs of the American Entomological Institute 17: 1–372. doi: 10.1111/j.1365-3113.1986.tb00171.x

Wahl DB (1986) Larval structures of oxytorines and their significance for the higher classification of some Ichneumonidae (Hymenoptera). Systematic Entomology 11: 117–127. doi: 10.1080/00222939000770041

Wahl DB (1990) A review of the mature larvae of Diplazontinae, with notes on larvae of Acaenitinae and Orthocentrinae and proposal of two new subfamilies (Insecta: Hymenoptera, Ichneumonidae). Journal of Natural History 24: 27–52.

Wahl DB (1991) The status of *Rhimphoctona*, with special reference to the higher categories within Campopleginae and the relationships of the subfamily (Hymenoptera: Ichneumonidae). Transactions of the American Entomological Society 117: 193–213.

Wahl DB, Gauld ID (1998) The cladistics and higher classification of the Pimpliformes (Hymenoptera: Ichneumonidae). Systematic Entomology 23: 299–303. doi: 10.1046/j.1365-3113.1998.00057.x

Wahl DB, Shanower TG, Hoelmer KA (2007) A new species of *Collyria* Schiødte (Hymenoptera: Ichneumonidae: Collyriinae), a parasitoid of *Cephus fumipennis* (Hymenoptera: Cephidae) in China, and potential biological control agent for *Cephus cinctus* in North America. Journal of the Kansas Entomological Society 80: 43–50. doi: 10.2317/0022-8567(2007)80[43:ANSOCS]2.0.CO;2

Yoder MJ, Mikó I, Seltmann KC, Bertone MA, Deans AR (2010) A gross anatomy ontology for Hymenoptera. PLoS ONE 5: e15991. doi: 10.1371/journal.pone.0015991

Yu D, van Achterberg C, Horstmann K (2009) World Ichneumonoidea 2008. Taxonomy, biology, morphology and distribution. [CD/DVD]. Taxapad®, Vancouver, Canada. [Available at http://www.taxapad.com].